37TH CONGRESS, 2d Session. } SENATE. { Ex. Doc.

REPORT

OF

THE SUPERINTENDENT

OF THE

COAST SURVEY,

SHOWING

THE PROGRESS OF THE SURVEY

DURING

THE YEAR 1861.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1862.

REPORT.

COAST SURVEY OFFICE,
Washington, D. C., December 15, 1861.

SIR: In accordance with law and the regulations of the Treasury Department, I have the honor to present my report, showing the progress of the Coast Survey of the United States during the surveying year, from November 1, 1860, to November 1, 1861.

At the first date mentioned the field parties had been arranged, under their respective heads, for duty on the coast of the lower sections of the Atlantic seaboard and the shores of the Gulf of Mexico; and though the temper of the public mind was then stirred, there was nothing on which to reckon hazard in sending the parties and vessels to continue work on the parts of the coast on which they had been respectively engaged. This being so, most of the parties intended for triangulation and topography were sent out, and all were well received. In the midst of events which hurried the national crisis in April last, most of the parties so engaged performed each an average amount of work for the season, and returned with the vessels, instruments, and equipage which had been used in the field. This was in accordance with my instructions, in connexion with which such means as were available had been provided to facilitate the return of the parties when further progress was impracticable. In two instances only were vessels seized and held, as will be again alluded to, with the attendant circumstances. In several others, instruments, which had been either stored with responsible persons at the close of the previous working season, or had been in actual use during the early part of this year, were forcibly taken by lawless persons in arms, and acting under assumed authority. These will also be mentioned again, in connexion with notices of the work done in the localities in which the seizures were made.

As the spring advanced, preparations were made for resuming the unfinished work in the northern sections of the Atlantic coast, and a much larger amount than usual has been performed, by the assignment to duty there of the force which, under other national aspects, would have been employed in the vicinity of Chesapeake bay.

If the events which at one period of the present year, arising out of attempts to disturb the stability of the government, left me room for any gratification, it would be expressed while stating that the field-work of the Coast Survey has not in amount materially fallen behind that of the previous years, considering the circumstances affecting progress in the past as well as now. In the office the aggregate of work done, arising in part out of the exigencies of the military and naval departments of the public service, and enhanced directly by the largely-increased demand for copies of maps and charts, has been much greater than usual. The activity of the office is still maintained, and the early connexion of field parties with the military and naval operations now in progress has given ample scope for constant employment.

Following the course pursued in making up my previous annual reports, a short summary of the general progress made will first be given, followed in order by a summary of that for the year which has just ended.

GENERAL STATEMENT OF PROGRESS.

The general progress sketch (No. 28) which accompanies this report gives at one view a clear idea of the present condition of the survey of the coast. Reference to it will show that the triangulation is continuous from the northeastern boundary of the United States, at the St. Croix river, (Passamaquoddy bay,) along the coast, and including the bays, of twelve of the seaboard States, to the boundary line between North and South Carolina. An unsurveyed interval of less than sixty miles occurs between Little river and Winyah bay, and from thence southward the triangulation is again continuous along the coast of South Carolina, Georgia, and on the eastern coast of Florida, including the bays, harbors, and sounds, to Matanzas inlet, below St. Augustine. North and south of Cape Cañaveral a stretch of about a hundred and sixty miles remains to be surveyed. The triangulation includes Indian River inlet and the course of the river northward as far as the Narrows. From Cape Florida it passes by a connected chain to the Marquesas, and, in a preliminary way, to the Tortugas, embracing the entire line of the Florida keys, and along the Main, with only a small interval, to Cape Sable. Charlotte harbor has been triangulated, and the western coast of the Florida peninsula, from Tampa to Cedar keys, including St. Joseph's bay and Clearwater harbor. From Ocilla river he triangulation is again continuous over St. Mark's harbor, quite through St. George's sound ; in preliminary form, through St. Joseph's bay, (north,) and over St. Andrew's bay. It includes Pensacola harbor and its dependencies, the Perdido entrance, Mobile bay and its approaches, and thence on westward, embraces Mississippi sound and Lake Borgne, and Lake Pontchartrain, as far as New Orleans. A branch of triangulation, connected with this, proceeds southward, through Isle au Breton sound, to the mouths of the Mississippi river. West of the delta it embraces Caillou bay and Atchafalaya and Côte Blanche bays, and the coast of Texas, with Galveston and Matagorda bays, Espiritu Santo, San Antonio, Corpus Christi, and Aransas bays and their dependencies, or, in a continued line, from the High islands to the head of the Laguna Madre.

The same sketch (No. 28) shows the progress in coast topography and hydrography relative to the triangulation. It will be seen that the largest intervals on the Atlantic side are on the coast of Maine and coast of Florida, with smaller gaps along the coast of several of the intermediate States. On the Gulf coast the topography is well up with the triangulation, but the hydrography not so far advanced.

The surveys on the Western coast, though more detached, are not the less important, all the harbors, anchorages, and headlands being included, as may be seen by reference to the sketch already mentioned.

In addition to other means employed for the determination of longitude, mention of which has been made from time to time in my annual reports, we have now added the prospect of the use of the telegraph line to the Pacific coast. Permission having been obtained for the object desired, arrangements are now making for employing the method which has been long in use in the survey, in fixing the longitude of a point on the Western coast.

DIVISIONS OF THE REPORT.

I. The introduction to the report gives, besides a general summary of progress and a synopsis of the progress made during the year, special remarks on subjects connected with the operations of the survey in field and office work.

II. The second division of the report contains detailed descriptions of the work done in each locality, arranged in geographical order, the whole being subdivided into sections, of which six embrace the coast of the United States on the Atlantic, three that on the Gulf of Mexico, and two the coast of the United States on the Pacific. A summary of the progress

made in drawing and engraving maps and charts is given with each of the sections to which they belong.

III. The Appendix contains, in addition to general lists of particulars relating to the progress of the survey, separate articles of scientific interest. For convenience in reference, the items are classified under separate heads, and the titles of all of them are given in a list as one of the indexes of the report. An abstract of the contents and an alphabetical index also accompany the report.

PROGRESS DURING THE SURVEYING YEAR 1860-'61.

The course of public events, while it has in some sections of the coast interrupted the plan laid out for completing their survey, has not, upon the whole, materially lessened the amount of work done during the present as compared with previous surveying years. Work which might have been somewhat longer deferred, without detriment to general interests, has fully replaced the ground that could not be occupied, and, as a result, the following abstract and the detailed report will show that the efficiency of the survey has not been at all impaired, either in comparative progress or in its adaptation to the peculiar circumstances of the government.

In Appendix No. 1 the localities in which the parties have worked are stated in geographical order, and the progress sketches, showing the localities, are arranged in like manner, and combined with such local charts and sketches as it has been deemed expedient to issue with this report. For ease in reference, the numbers of the progress sketches are stated under the heads of sections in the general statement of the progress of the year which will now be given:

SECTION I. *Coast of Maine, New Hampshire, Massachusetts, and Rhode Island.—(Sketches Nos.* 1, 2, *and* 3.)—The triangulation of Passamaquoddy bay between Deer island and Campo Bello has been executed, and that of Dyer's harbor, Goldsborough bay, and Prospect harbor (coast of Maine) completed. The triangulation of Penobscot bay has been extended northward to the vicinity of Belfast, and that of the coast eastward from the entrance of the Penobscot nearly to Mount Desert island. Mount Monadnoc, in New Hampshire, has been occupied as a primary station for connecting the two primary bases of this and the adjoining section by a *direct* course of triangles, and the magnetic elements have been determined in its vicinity.

The topography has been commenced on the islands of Passamaquoddy bay; that of Rockland harbor and of the western shore of Penobscot bay to South Thomaston has been completed, including the shores of Owl's Head bay and Muscle Ridge channel. The topography of Woolwich peninsula has been extended from the shores of Back river westward nearly to a junction with the survey of the Kennebec opposite to Bath. The detailed plane-table survey of the shores of the Kennebec and Androscoggin rivers has been in progress above their junction; that of the eastern side of Harpswell Neck, and the shore line survey of Casco bay between Freeport and Yarmouth, has been completed. The special topography required for the re-survey of Boston harbor has been in progress, and that of the shore of Cape Cod bay between Barnstable harbor and West Sandwich completed. The topography of the shores of Mount Hope bay has been continued, in connexion with the adjacent parts of the shores of Narragansett bay and Prudence island.

The hydrography of the season has included the channel in Passamaquoddy bay between Deer island and Campo Bello; that of the Kennebec river has been extended from Bath upwards through Merrymeeting bay to Swan island; and that of Casco bay has been nearly completed by soundings between the islands northward and eastward of Portland harbor, and between the harbor and Harpswell Neck. Special observations have been made on the currents in Boston harbor for the re-survey undertaken by the city of Boston. The hydrography of

Barnstable harbor has been executed, and current observations have been made in Cape Cod bay. Asia Rip and Phelps's Bank have been further examined and developed, and three small shoals found in their vicinity have been sounded out. The hydrography of Narragansett bay has been extended between Canonicut island and Rhode Island, and from thence northward to Mount Hope bay. Tidal and magnetic observations have been continued at Eastport, Me., and tidal observations at the Charlestown navy yard, Mass.

The engraving of coast maps and charts, No. 12, Nantucket sound; No. 13, Buzzard's bay and Vineyard sound; and of No. 14, from Point Judith to Block island, has been completed, and additions have been made to the progress sketch of the section. Progress has been made in the drawing and engraving of coast maps and charts, No. 8, Atlantic coast from Seguin island to Kennebunkport; No. 9, from Cape Neddick to Cape Ann; No. 11, from Plymouth harbor to Hyannis harbor; and in the engraving of general coast chart No. II, from Cape Ann to Gay Head; in that of preliminary sea-coast chart No. 3, Cape Small Point to Cape Cod; and on the chart of Portland harbor. The drawing has been continued and the engraving commenced of the charts of the Sheepscot and Kennebec rivers; and the drawing has been commenced of general sea-coast chart No. I, Atlantic coast, Quoddy Head to Cape Cod; of coast map and chart No. 7, Muscongus bay to Portland; and for a finished chart of Barnstable harbor.

SECTION II. *Coast of Connecticut, New York, New Jersey, Pennsylvania, and part of Delaware.*—(*Sketch No.* 7.)—Two primary stations have been occupied, viz: Bald hill and Box hill, in Connecticut, for directly connecting the primary base on Epping plains with that on Fire island. Magnetic observations were made at the same stations. The triangulation of the Connecticut river has been extended from its entrance upwards to Goodspeed's landing, and the revision of the secondary work on the coast of New Jersey, from Sandy Hook to Green island. The topography of the Hudson river has been extended during the season above Rhinebeck, and the shore line traced between Fort Montgomery and Fishkill landing and Newburg. The hydrography of the Hudson has been continued between Rhinebeck and Barrytown. Special hydrographic examinations have been made in New York harbor and off Barnegat and Cape May, and a line of soundings has been run north and south off the coast of New Jersey. The hydrography of the channels of the Delaware river in the vicinity of Pea Patch island has been revised for the use of the chief engineer of the army, and supplementary soundings have been made in the Delaware between the mouth of the Schuylkill and Richmond. The regular series of tidal observations has been continued in New York harbor.

The drawing has been completed and the engraving continued for the new edition of coast map and chart No. 21, New York bay and harbor; and the large manuscript map for the commissioners on harbor encroachments has been finished and delivered to the State authorities at Albany. The engraving of the sheet of the Hudson from the river entrance upward to Sing Sing, and the drawing of the adjoining upper sheet, reaching to Poughkeepsie, have been continued, and a new progress sketch of the section has been drawn and engraved.

SECTION III. *Coast of part of Delaware, Maryland, and part of Virginia.*—(*Sketch No.* 10.)—The triangulation of the Potomac river has been extended upwards from Blakistone island, completing the preliminary work to the vicinity of Swan Point. Minute topographical surveys have been made of the environs of Washington city and of the adjoining parts of the District of Columbia, of Montgomery county, Md., and of Fairfax county, Va. The shore line of the Potomac has been traced from Piney Point to Blakistone island, and plane-table reconnaissances and soundings have been made at White House Point, Mathias Point, and Lower Cedar Point, in addition to a general hydrographic reconnaissance of the Potomac between Blakistone island and Georgetown, D. C. The series of tidal observations undertaken at the Washington navy yard has been completed, and the continuous series at Old Point Comfort kept up regularly.

Progress has been made in the drawing of coast maps and charts, No. 29, Atlantic coast

from Isle of Wight, Del., to Chincoteague inlet, Va., and No. 30, from Chincoteague inlet to Great Machipongo inlet, Va.; also in the engraving of the following sheets of the Chesapeake series, viz: No. 32, from Magothy river to Hudson river, Md.; No. 34, from the Potomac river to Pocomoke sound; No. 35, from Pocomoke sound to York river; No. 36, from York river to the entrance of Chesapeake bay; and on that of the sheet of Rappahannock river from Punch Bowl to Occupacia creek. The drawing, lithographing, and engraving of the upper sheet of Patuxent river, from Point Judith to Nottingham; the drawing and engraving of the chart of St. Mary's river, Md.; and the engraving of the Rappahannock sheet from the river entrance to Punch Bowl; of coast maps and charts, No. 31, Chesapeake bay from the Susquehanna to Magothy river; No. 33, Chesapeake bay from the Hudson to the Potomac river, have been completed, as also the photographing and lithographing of the preliminary chart of James river, and the drawing and lithographing of the preliminary chart of the Potomac river. Additions have been made to the progress sketch of the section, and the drawing for a finished chart of the Patuxent river has been commenced.

SECTION IV. *Coast of part of Virginia, and part of North Carolina.—(Sketch No.* 11.)—Supplementary topography for completing the large chart of Albemarle sound has been executed on Roanoke island, on Durant's island, and at the mouths of the Chowan, Cushai, and Roanoke rivers. Soundings have been made on a line off the coast of Maryland and Virginia, and a special examination made in the vicinity of an alleged shoal off the "False cape," southward of Cape Henry. Hydrographic reconnaissances have been made of the inlets leading into Pamplico sound, and a thorough resurvey of the approaches and channel of Hatteras inlet.

The drawing and engraving of additions to the two sheets of Albemarle sound (coast maps and charts Nos. 40 and 41) have been executed, and the drawing of a preliminary chart of the coast of North Carolina, from Oregon inlet to Ocracoke inlet, has been lithographed in the office. The engraving of the sketch of North Landing river (Currituck sound) has been completed, and additions have been made to the progress sketch of the section.

SECTION V. *Coast of part of North Carolina, and coast of South Carolina and Georgia.—(Sketch No.* 13.)—The main triangulation between Port Royal sound and Savannah river has been continued, and the secondary triangulation of the coast of Georgia completed, by a series of stations, which include the Inland passage behind Cumberland island. The detailed topography of Port Royal sound has been resumed, and is now in progress on its northern side, on the sea islands and water passages between them. The hydrography of that sound, and of the rivers passing into it, is also in progress. The regular series of tidal observations at the Charleston custom-house, S. C., was continued until the close of April of the present year.

The drawing has been completed, and the engraving, in preliminary form, of the chart of Ossabaw sound. Additions have been made to the drawing of the preliminary chart of Savannah river, and the engraving of that chart has been continued, the drawing of the hydrography of the rivers comprising the inland passage from St. Helena sound to Beaufort river, and additions to the chart of Port Royal and Broad river have been completed. The engraving of preliminary sea-coast chart No. 14, from Cape Romain, S. C., to Tybee, Ga., has been completed as far as material allows, and the drawing continued. Additions have been made to the progress sketch of the section, and to plates of charts previously engraved. The drawing of general coast charts No. VI, Ocracoke inlet, N. C., to Charleston, S. C.; No. VII, Winyah bay, S. C., to St. John's river, Fla.; of coast maps and charts No. 53, Rattlesnake shoals to St. Helena sound, S. C.; No. 54, Fripp's inlet, S. C., to Ossabaw sound, Ga.; and the engraving of the preliminary charts of Sapelo sound and St. Simon's sound, Brunswick harbor, and Turtle river, have been continued.

SECTION VI. *Coast, keys, and reefs of Florida.—(Sketches Nos.* 14 *and* 15.)—The triangulation of the eastern coast of Florida has been made continuous from Fernandina harbor to the completed survey of the St. John's river; that of Indian river has been extended northward

to the Narrows from Willis's bay, and that of the inside keys of Florida from Pie key to Deep Point, in connexion with stations on the main land to the southward and westward of Barnes's sound; and that of Charlotte harbor has included the passage leading from Punta Rasa, between Pine island and the main. The topography of the eastern coast of Florida has been completed between St. John's river and St. Augustine harbor by a survey, which includes the courses of the North and Guano rivers. The plane-table survey of Indian River inlet, within the triangulation of last season, has been executed, and additional topography done on the keys of Barnes's sound. The topography of the dependencies of Charlotte harbor has been nearly completed. Tidal observations were continued at Fort Clinch (Fernandina, Fla.) until April, and at the Tortugas until May.

The drawing of coast map and chart No. 68, from Key Biscayne to Carysfort reef, has been completed, and additions have been made to the progress sketch of the section. Progress has been made in the drawing and engraving of general coast chart No. X, Florida reef, from Key Biscayne to Marquesas key; in the engraving of coast map and chart No. 71, from Newfound Harbor key to Boca Grande key; of St. Augustine harbor; and in the drawing of coast map and chart No. 58, from St. Andrew's sound, Ga., to St. John's river, Fla.

SECTION VII. *Part of the western coast of the Florida peninsula, and coast of West Florida.—(Sketch No.* 16.)—The longitude of Pensacola has been determined by telegraph, in connexion with Mobile, and observations made at the first-named city for latitude, azimuth, and the magnetic elements. The triangulation of the western coast of the peninsula below Cedar Keys has advanced from Bayport southward to the entrance of Tampa bay, and now includes St. Joseph's bay (south) and Clearwater harbor. Progress has been made by opening lines and setting signals for the triangulation of St. Joseph's bay, (north,) and for connecting the surveys of St. George's sound and St. Andrew's bay. Additional stations have been occupied, and the triangulation of Blackwater bay has been extended from Escribano point to Bagdad. The topography of the western coast of Florida peninsula has been completed in the vicinity and including the town of Bayport, making the plane-table survey continuous between it and Cedar Keys.

Progress has been made in the drawing of coast map and chart No. 81, Gulf coast from Chassahowitzka river, Fla., to Cedar Keys, and in the engraving of important additions to the chart of the western part of St. George's sound. The drawing and engraving of the preliminary chart of Cedar Keys, (new edition;) of Escambia and Santa Maria de Galvaez bays, (in preliminary form;) and the drawing of Apalachicola bay, have been completed, and additions have been made to the progress sketch of the section.

SECTION VIII. *Coast of Alabama, Mississippi, and part of Louisiana.—(Sketch No.* 18.)—Progress has been made in determining points by triangulation for the plane-table survey of the Southwest Pass, (Mississippi delta.) Tidal observations were continued until April at Great Point Clear, (Mobile bay,) and also at Isle Dernière. A series commenced at the Mississippi delta was continued until February.

The drawing and engraving of the preliminary chart of Passe à Loutre, (Mississippi delta,) and the engraving of coast map and chart No. 92, Gulf coast from Round island to Grand island, have been completed. The drawing has been continued on coast map and chart No. 93, Lake Borgne to Lake Pontchartrain; and additions have been made to the plates of lines of deep-sea soundings in the Gulf of Mexico, and progress sketch of the section.

SECTION IX. *Coast of part of Louisiana and coast of Texas.—(Sketch No.* 19.)—The triangulation of the coast of Texas has been extended from Stevenson's Point northward and eastward to the High islands, including the intervening bayous. Supplementary topography has been executed completing the detailed surveys of the shores of St. Charles, Copano, and Aransas bays. Tidal observations were continued at Calcasieu, La., until May, when the instruments were seized by unauthorized persons and the observer arrested.

The drawing and engraving of coast map and chart No. 107, Gulf coast from Oyster bay to Matagorda bay; the engraving of coast map and chart No. 106, Galveston bay to Oyster bay; and the drawing of coast map and chart No. 108, Matagorda and Lavaca bays, and of general coast chart No. XVI, Galveston bay to the Rio Grande, have been continued. Additions to the progress sketch of the section have been made.

SECTION X. *Coast of California.—(Sketches Nos. 20 and 21.)*—The triangulation required for connecting the Santa Barbara islands with stations on the main coast of California has been in progress. The topography from Point Piedras southward, including the shores of Half Moon bay, has been commenced, to make the plane-table survey complete between San Francisco entrance and the southern part of Monterey bay. The plane-table survey of the coast of California has been extended northward of Point Reyes to embrace the shores of Tomales bay, and the hydrography of that bay and its approaches has been completed. Tidal observations have been kept up at San Diego and San Francisco, with self-registering tide gauges.

The drawing has been completed, and the engraving, in preliminary form, of the chart of Drake's bay; the drawing of the map of Napa creek, and that of the chart of the approaches to San Francisco bay, has been completed; and the engraving has been continued on the chart of San Pablo bay. Additions have been made to the progress sketches of the section, and to plates of charts previously engraved.

SECTION XI. *Coast of Oregon and that of Washington Territory.—(Sketch No. 24.)*—The triangulation of the greater part of Coose bay, Oregon, has been completed, and connected with a preliminary base measured this season; the topography of that bay is well advanced, and the hydrography is now in progress. Observations have been made at Coose bay and at Gray's harbor, W. T., for latitude and azimuth. The preliminary base at Gray's harbor has been remeasured and marked, and the topography of the shores of the harbor completed.

The drawing has been completed and the engraving commenced of the chart of Coquille river, Oregon, and additions have been made to the progress sketch of the section.

MAPS AND CHARTS.

In the divisions of the Coast Survey office immediately concerned in the preparation and distribution of maps and charts more than the usual force has been employed, to meet the increased demand for information in regard to the coast and harbors of the United States. This has not been limited merely to points which have recently become the sites of actual warfare. The inquiry has been general, and has been promptly met as to the exigencies of the military and naval departments and defensive purposes of the seaboard States, but not with reference to the numerous calls arising from the interest felt by intelligent men at large for precise geographical information. Aside from its questionable expediency in a time like this, such a course presents difficulties in discriminating in all cases those to whom the annual reports and maps and charts might with propriety be distributed as heretofore. No pains have been spared in securing this result within limits of entire safety to national interests, the cases of applicants who were not well known having been referred to the representative of the congressional district from which the application had been mailed.

In order to meet the call for charts from the Naval Observatory to supply national vessels, two lithographic presses have been set up in the Coast Survey office, and an aggregate of more than two thousand copies of maps and charts printed from them.

The entire number of separate charts and sketches now completed, including, as well as those that are engraved, the lithographs referred to, is three hundred and twenty-eight, exclusive of seventeen plates of progress sketches.

Seventy-nine sheets have been worked on in the Drawing Division within the past year. Of this number, three are finished charts, twenty-one finished maps and charts, nineteen are

sketches, and twenty maps and sketches drawn for lithographic transfer. Fifty-eight sheets have been completed, and twenty-one are in progress. Of those completed, seven are finished maps, and the others preliminary charts and sketches.

In the Engraving Division nine first class maps and new editions of two have been completed during the year, and twenty are in progress.

Eight plates of second class charts and sketches and six diagrams have been engraved, and six are still in progress, and various additions and corrections to five plates previously issued have been engraved.

This gives a total of twenty-three completed and twenty-six in progress, or of forty-nine engraved or engraving within the year.

Twenty separate maps and sketches have been made and printed by the lithographic process at the office.

The following list contains the titles of charts and sketches which accompany this report. They are arranged geographically, and for convenience are numbered, the progress sketches and some of the charts being referred to under the several sections in the body of the report by corresponding numbers:

1.—A. Progress sketch, Section I, (primary triangulation.)
2.—A. bis. Progress sketch, Section I, northern part, (secondary triangulation, topography, and hydrography.)
3.—A. bis. Progress sketch, Section I, southern part, (secondary triangulation, topography, and hydrography.)
4.— Kennebec river, Me.
5.— Barnstable harbor, Mass.
6.— Mount Hope bay, R. I.
7.—B. Progress sketch, Section II.
8.— New York bay and harbor, (new edition.)
9.— Hudson river, from Haverstraw to Poughkeepsie.
10.—C. Progress sketch, Section III.
11.—D. Progress sketch, Section IV.
12.— North Landing river, (head of Currituck sound, Va.)
13.—E. Progress sketch, Section V.
14.—F. Progress sketch, Section VI, (Florida peninsula.)
15.—F. bis. Progress sketch, Section VI, (Florida reefs and keys.)
16.—G. Progress sketch, Section VII.
17.— Cedar Keys, (new edition.)
18.—H. Progress sketch, Section VIII.
19.—I. Progress sketch, Section IX.
20.—J. Progress sketch, Section X, (Pacific coast, from San Diego to San Luis Obispo.)
21.—J. bis. Progress sketch, Section X, (Pacific coast, from San Luis Obispo to Bodega head.)
22.— Petaluma and Napa creeks, (San Pablo bay, Cal.)
23.— Tomales bay, Cal.
24.—K. Progress sketch, Section XI.
25.— Coquille River entrance, Oregon.
26.— Koose bay, Oregon.
27.— Washington sound, W. T., (new edition.)
28.— General progress sketch, Atlantic, Gulf, and Western coast.
29.— Diagram illustrating phenomena of the solar eclipse of July, 1860.
30.— Charts of isogonic lines for the coast of Virginia, North Carolina, South Carolina, Georgia, and for the Gulf of Mexico.
31.— Diagrams illustrating the results of experiments on the expansion of drawing paper.

ESTIMATES FOR THE FISCAL YEAR 1862-'63.

The estimates for the next fiscal year are but little more than one-half of those of the present year. They will enable us to continue the regular work of the survey wherever our parties can move freely, to continue the working up of the information in regard to the coast already collected, and important to the government and its officers, civil, naval, and military, to collect new information indispensable to the movements of our fleets, and to preserve the essential organization of the survey, which has shown itself so variously useful both in the past and present.

During the past year I have kept steadily in view the directions approved by the department, as far as circumstances permitted, and have been generally successful in their execution, as my detailed report will show. I was aware that, under any circumstances, the information to be gathered must be of great value, and, with a proper flexibility in the conduct of the field and office work, might be immediately available to the country. These details belong to my annual report.

The survey was, as usual, in progress in every seaboard State and Territory of the United States, either in work in the field, or afloat, or in the office, pressing forward to completion according to a determined plan, which would have finished it on the Atlantic and Gulf coast in some eight years. In November, the exigencies of the treasury prevented the regular supply of funds for the southern parties, and in some cases their organization, until the development of the rebellion showed that the property of the survey was not safe in certain of the States. Two of our vessels were seized in Charleston harbor, and directions were necessarily given to the assistants in the survey to leave their several localities of work whenever they were molested in its execution, or the property of the government was in jeopardy. These instructions were well carried out, the assistants waiting until the necessity for removal was apparent. Insignificant losses of property only were sustained, except in the case of a vessel seized in Aransas harbor, Texas, having put in there from unseaworthiness. The survey has thus made considerable progress on the southern coast, notwithstanding the untoward circumstances of the time. During the spring and summer the parties were removed to the northern sections, and worked there in full force, and with full means, so that this part of the survey has advanced more than in its usual proportion. The call for the services of the officers of the army and navy being imperious, the operations generally have been executed by the civilians. The advantages of the organization of the work, which have often been stated, were never so fully displayed as in this exigency. The regular work was carried on systematically, though upon a reduced scale. The navy found on its roll, officers who had a knowledge of the harbors and coasts from service on the survey. To the army list were returned officers skilled in reconnaissance, and in the other various operations of the survey, and familiar with the coast and its shore-lines. The vessels of the survey, both steam and sail vessels, were ready in the emergency for the revenue and naval services, and were freely yielded to their use.

The material in the Coast Survey office was rapidly put in the shape of hydrographic notes, and by lithographic and photographic processes the unpublished maps and charts, and memoirs of the coast, were placed at the disposal of the departments of the government, and of the officers engaged in consultations in regard to or in the execution of operations along the coast. The calls for copies of charts of harbors and of the coast of the United States from the active chief of the hydrographic office, to distribute to the vessels of our navy, have been numerous, and have taxed greatly the resources of the office.

In the five months preceding the first of November, some six thousand copies of maps and charts have been supplied to the hydrographic office for the use of the navy. Copies of me-

moirs and accompanying charts have been furnished to government officers. I shall in my annual report call your attention to the expressions by the highest authorities of the several services to the great importance of the information furnished by the Coast Survey. The direction of its usefulness has been modified by circumstances, but its extent has been rather increased than diminished.

The topographical surveys made by the assistants of the Coast Survey, in co-operation with the accomplished officers of topographical engineers, have supplied rapidly, maps essential to the operations of the army. Especially has this been the case in the neighborhood of the capital, where the immediate completion of the map of the District of Columbia, and of its approaches, was called for by the military authorities, and executed by authority of the Secretary of the Treasury, under the joint direction and at the joint cost of the Coast Survey and of the military authorities.

The Atlantic coast triangulation is now complete, with an interval of some sixty miles, from Passamaquoddy, in Maine, to Matanzas inlet, south of St. Augustine, Florida. The gap between Cumberland sound, Georgia, and the St. John's river, Florida, was filled up last season. The line of coast thus triangulated, measured in the most general way, is not less than 1,590 miles. The extension of the surveys in Florida, of the Florida reefs and keys and coast, Louisiana, and Texas, and in the Gulf generally, will be stated in detail in my annual report. The hydrography, and perhaps other portions of the work, may be readily extended—filling up present deficiencies—by vessels of the Coast Survey accompanying the fleets. The advantage of a regular system by which efforts shall be directed to completing the charts on the coast will be readily appreciated. I have introduced into the estimates such amounts as may be usefully and economically employed for these objects, and am prepared to submit to you the strongest evidence of their importance and practicability, should there be any doubt in relation to them.

The progress on the Pacific coast has been satisfactory, embracing an extension of the usual work in California, Oregon, and Washington Territory. The diminution of the appropriation, and the changes in the officers serving there, have made certain abatements from the progress of previous years, which it will be my duty to state in my annual report, notwithstanding which, the progress has been, as above stated, satisfactory. The Secretary of the Navy has consented to the detail of an experienced and enterprising officer for the hydrography on the Pacific coast, to replace the able officer formerly engaged there, a great boon to the survey, when the necessity for the exercise of every resource in this important and extensive field is considered.

The completion of the telegraph line between San Francisco and Washington will afford us the most admirable and simple means of determining the difference of longitude between these points, with an accuracy much beyond that attainable by any other known method. The intelligent president of the line will give us every facility for this purpose. In this connexion I may mention that the observations of the Pleiades occultations are yielding, under Professor Peirce's computations, the most promising results for longitude between America and Europe.

The estimates include, as usual, separate items for the Atlantic and Gulf coast, Florida reefs, and Western coast, but they do not suppose the usual facilities from the War and Navy Departments by the detail of officers, except to the very limited extent of the present detail. The civil organization is taken at its present numbers, reduced by voluntary military service, and by other reductions which will be made to the very point where efficiency would be impaired, in the confident expectation that this endeavor to meet the circumstances of the country will be appreciated, and that further reductions, which would certainly impair the value of the work, will not be made.

In 1856–'57 the appropriation for the Coast Survey was $535,000; in 1858–'59, $452,800; the exigencies of the treasury in 1860–'61 caused a reduction to $402,800. The estimates now presented are for $299,000, or less by $103,800 than the appropriation of last year. The reduction is twenty-four per cent. of the amount then appropriated, and thirty-four per cent. of the amount now estimated.

It will enable us to keep the office up to the necessary point of efficiency for communicating information, indispensable to the government, and to continue the field-work and surveys afloat, at the desirable points of progress.

ESTIMATES IN DETAIL.

For general expenses of all the sections,* namely, rent, fuel, materials for drawing, engraving, and printing, and ruling forms, binding, transportation of instruments, maps and charts, for miscellaneous office expenses, and for the purchase of new instruments, books, maps, and charts $19,000

SECTION I. *Coast of Maine, New Hampshire, Massachusetts, and Rhode Island.* FIELD-WORK.—To continue the primary triangulation in this section, and to make the astronomical and magnetic observations connected with it; to continue the triangulation of *Passamaquoddy bay*, to extend the secondary triangulation from *Penobscot bay* and the *Fox islands* along the coast towards *Mount Desert*, from *Englishman's bay*, eastward, and up the *Penobscot river;* to continue the topography of *Passamaquoddy bay* and *Eastport harbor, Me.;* to commence that of *Goldsborough harbor, Me.;* to continue that of the approaches to *Penobscot bay*, and of *Rockland, Rockport, and Camden harbors, Me.;* to continue that of the *Kennebec and Sheepscot rivers, Me.*, and to connect the surveys; to complete that of *Cape Cod bay, Mass.;* to continue that of *Bristol Neck and the islands and main of Narragansett bay in R. I. and Mass.;* to continue the in and off shore hydrography of the coast of Maine, including *Passamaquoddy, Muscongus, and Penobscot bays*, and the ledges off the coast; to continue the tidal and magnetic observations at *Eastport and Portland*, and to make tidal observations in connexion with the hydrography: OFFICE-WORK.—To make the computations required by the field-work; to commence the drawing of *Damariscotta entrance, Me.; Rockland harbor, Me.; Eastport harbor, Me.; Bristol harbor and approaches, R. I.; Mount Hope bay and part of Narragansett bay, R. I.;* to continue that of general coast chart No. I., *Quoddy head, Me., to Cape Cod, Mass.;* coast map and chart No. 8, *Seguin island to Kennebunkport, Me.;* coast map and chart No. 7, *Muscongus bay to Portland, Me.;* coast map and chart No. 9, *Kennebunkport, Me., to Cape Ann, Mass.*; coast map and chart No. 11, *Plymouth to Hyannis, Mass.;* to complete the *Sheepscot and Kennebec rivers, Me., Barnstable harbor, Mass.;* general coast chart No. II, *Cape Ann to Gay Head;* to commence the engraving of preliminary sea-coast chart No. 2, *Isle au Haut to Cape Elizabeth, Me., Barnstable harbor, Mass.;* coast map and chart No. 7, *Muscongus bay to Portland, Me.;* coast map and chart No. 10, *Ipswich to Green harbor, Mass.;* to continue that of coast map and chart No. 8, *Seguin island to Kennebunkport, Me.;* coast map and chart No. 9, *Kennebunkport to Cape Ann, Mass.;* coast map and chart No. 11, *Plymouth to Hyannis, Mass.;* to complete *Sheepscot and Kennebec rivers, Me.;* general chart No. II, *Cape Ann to Gay Head, Mass.;* preliminary sea-coast chart No. 3, *Cape Small point to Cape Cod, Mass.*, and *Portland harbor, Me.*, will require 61,000

* Viz: of all included in this item, inclusive of sections I to IX, and exclusive of section VI.

SECTION II. *Coast of Connecticut, New York, New Jersey, Pennsylvania, and part of Delaware.* FIELD-WORK.—To continue the triangulation of the rivers of *Connecticut* and the verification of triangulation on the sea-coast of *New Jersey;* to commence the topography of the shores of *Connecticut river;* to continue that of the *Hudson;* to commence that of the sea-coast of *New Jersey,* (verification;) to continue the hydrography of the *Hudson river* and the verifications off the coast of *New Jersey;* to continue the tidal observations in the section: OFFICE-WORK.—To make the requisite computations; to commence the drawing of *Hudson river* No. 3, *Poughkeepsie to near Hudson;* to continue *Hudson river* No. 2, *Sing Sing to Poughkeepsie;* to complete coast map and chart No. 21, *New York bay and harbor, Hudson river* No. 1, from the *entrance to Sing Sing;* to commence the engraving of *Hudson river* No. 2, *Sing Sing to Poughkeepsie;* to continue that of coast map and chart No. 21, *New York bay and harbor;* to complete *Hudson river* No. 1, from the *entrance to Sing Sing;* and coast map and chart No. 25, *Delaware bay and river,* (new survey,) will require $17,500

SECTION III. *Coast of part of Delaware and that of Maryland, and part of Virginia.* FIELD-WORK.—To continue the astronomical and magnetic observations required in the section; to examine and preserve the more important triangulation stations; to continue, if practicable, the survey of the *Potomac* to replace the reconnaissance map; to complete the surveys of the *District of Columbia and approaches,* and, if practicable, of *James river* and the lower part of *Chesapeake bay;* and to continue the off-shore hydrography of the section: OFFICE-WORK.—To make the reductions and computations required; to commence the drawing of *Potomac river, Md.,* (upper sheet;) *Potomac river, Md.,* (lower sheet;) to continue that of coast map and chart No. 30 bis, between *Great Machipongo inlet and Cape Henry;* coast map and chart No. 30, *Chincoteague inlet to Great Machipongo inlet, Va.;* coast map and chart No. 36, *Chesapeake bay, York river, to entrance of bay, Va.;* general coast chart No. IV, *Cape May to Currituck, Va.;* to complete coast map and chart No. 35, *Chesapeake bay, Pocomoke sound, to York river, Va.; Patuxent river, Md.,* (lower sheet;) coast map and chart No. 29, *between Green run inlet and Little Machipongo inlet, Va.;* to commence the engraving of *Potomac river, Md.,* (upper sheet;) *Potomac river, Md.,* (lower sheet;) general coast chart No. IV, *Cape May to Currituck, Va.;* to continue that of coast map and chart No. 36, *Chesapeake bay, York river, to entrance of bay, Va.;* coast map and chart No. 29, between *Green river inlet and Little Machipongo inlet, Va.;* to complete coast map and chart No. 35, *Chesapeake bay, Pocomoke sound to York river, Va.;* coast map and chart No. 32, *Chesapeake bay, Magothy river to Hudson, Va.;* and coast map and chart No. 34, *Chesapeake bay, Potomac river to Pocomoke sound, Va.,* will require 13,500

SECTION IV. *Coast of part of Virginia and of part of North Carolina.* FIELD-WORK.—To complete, if practicable, the primary triangulation of *Pamplico sound,* and the secondary triangulation connected with it; to make the necessary magnetic observations; to complete the topography of the outer shore of *North Carolina south of Hatteras, to Core sound;* to continue the in and off shore work of the sea-coast of *North Carolina,* and of the sounds, and the observations of tides and currents, and of the *Gulf Stream:* OFFICE-WORK.—To make computations from the field data; to commence the drawing of coast map and chart No. 38, *Payne's Hill, Va., to Bodies Island Light, N. C.;* to continue that of general coast chart No. V, *Currituck sound to Cape Fear, N. C.;* general coast chart No. VI, *Ocracoke to Charleston, S. C.;* coast map and chart No. 37, *Cape Henry to Currituck*

sound, N. C.; to commence the engraving of coast map and chart No. 46, *Cape Lookout to Bogue inlet;* general coast chart No. V, *Currituck sound to Cape Fear, N. C.;* coast map and chart No. 37, *Cape Henry to Currituck sound, N. C.;* and coast map and chart No. 48, *Barren inlet to Lockwood's Folly inlet, N. C.*, will require $15,000

SECTION V. *Coast of part of North Carolina and that of South Carolina and Georgia.* FIELD-WORK.—To execute such work of triangulation, topography, and hydrography as may be practicable in the section, filling up the places not yet embraced in the surveys: OFFICE-WORK.—To continue the computations from field records; to commence the drawing of coast map and chart No. 56, *Sapelo sound to St. Simon's sound, Ga., Wassaw sound, Ga., Doboy sound, Ga., St. Catharine's sound, Ga.;* to continue that of coast map and chart No. 53, between *Stono inlet and Fripp's inlet, S. C.;* coast map and chart No. 54, *Fripp's inlet, S. C., to Ossabaw sound, Ga.;* general coast chart No. VII, *Winyah bay, S. C., to St. John's river, Fla.;* to complete *Savannah river, Ga.;* to commence the engraving of coast map and chart No. 53, *Stono inlet and Fripp's inlet, S. C.;* coast map and chart No. 54, *Fripp's inlet to Ossabaw sound, Ga., Coosaw river, S. C., Wassaw sound, Ga., Doboy sound, Ga., St. Catharine's sound, Ga.;* and to complete lines of deep-sea soundings will require 16,000

SECTION VI. *Coast, keys, and reefs of Florida.* (See estimates of appropriation for those special objects.)

SECTIONS VII, VIII, and IX. *Part of the western coast of Florida, northern coast of Florida, coasts of Alabama, Mississippi, Louisiana, and Texas.* FIELD-WORK.—To continue such portions of triangulation, topography, and in and off shore hydrography as may be practicable in filling up the portions unsurveyed of these coasts, (contemplates the employment of two steamers and two sailing vessels:) OFFICE-WORK.—To make computations; to continue the drawing of coast map and chart No. 84, *Ocilla river to Crooked river, Fla.;* coast map and chart No. 85, *St. George's sound*, (eastern part;) coast map and chart No. 88, *Choctawhatchee bay to Pensacola bay, Fla.;* general coast chart No. XIII, *Waccassassa river to Choctawhatchee river, Fla.;* to commence *Mobile bay*, upper part, (resurvey;) coast map and chart No. 96, *Delta of the Mississippi, La.;* to continue general coast chart No. XIV, *Choctawhatchee river to the Mississippi delta, La.;* to commence *Corpus Christi bay, Texas;* coast map and chart No. 109, *Matagorda bay to Aransas pass, Texas;* coast map and chart No. 110; to continue general coast chart No. XVI, *Galveston to the Rio Grande, Texas;* to commence the engraving of coast map and chart No. 81, *Chassahowitzka river to Cedar Keys, Fla.;* to complete lines of deep-sea soundings, *Gulf of Mexico;* to commence *Mobile bay*, upper part, (resurvey;) coast map and chart No. 93, *Lake Borgne to Lake Pontchartrain, La.;* coast map and chart No. 100, *Point au Fer to Marsh island, La., Corpus Christi bay, Texas;* general coast chart No. XVI, *Galveston to the Rio Grande, Texas;* to continue coast map and chart No. 108, *Matagorda and Lavaca bays, Texas;* coast map and chart No. 107, *Oyster bay to Matagorda bay, Texas;* and to complete coast map and chart No. 106, *Galveston bay to Oyster bay, Texas*, will require 36,000

Total for the Atlantic coast and Gulf of Mexico 178,000

The estimates for the Florida coast, keys, and reefs, and for the western coast of the United States, are intended to provide for the following progress:

SECTION VI. *Coast, keys, and reefs of Florida.* FIELD-WORK.—To continue, if practicable, the surveys of the eastern coast of the peninsula from the present limits; to complete the triangulation and topography of the southern keys and coast of the peninsula from *Card's sound* to the work at *Cape Sable;* to complete the hydrography of the reefs, and to run off-shore lines from the reef and coast of the section; to continue the magnetic observations at *Key West* and the tidal observations at the *Tortugas:* OFFICE-WORK.—To compute results from field records; to commence the drawing of coast map and chart No. 59, *St. John's river to St. Augustine, Fla.;* coast map and chart No. 73, the *Tortugas, Fla.;* topography of *Charlotte harbor, Fla.;* to continue coast map and chart No. 58, *St. Andrew's sound, Ga., to St. John's river, Fla.;* to commence the engraving of coast map and chart No. 73, the *Tortugas, Fla.;* topography of *Charlotte harbor, Fla.;* coast map and chart No. 69, *Garden key to Lower Matacumbe key, Fla.;* coast map and chart No. 70, *Long key to Big Pine key, Fla.;* to continue general coast chart No. X, *Florida reefs and keys, Key Biscayne to Marquesas keys;* and to complete coast map and chart No. 71, *Newfound Harbor key to Boca Grande key,* will require $11,000

SECTION X. *Coast of California.* FIELD-WORK.—To continue the triangulation from the *Santa Barbara* base northward and westward towards *Point Conception,* and to complete that of the islands off *Santa Barbara channel;* to continue the triangulation from *Bodega* northward; to make astronomical and magnetic observations in connexion with the triangulation; to continue the topography in connexion with the *Santa Barbara and San Francisco* triangulations; to complete that between *San Francisco and Monterey,* and to extend that north from *Bodega;* to continue the hydrography off and in shore along the coast from the previous limits; to continue the tidal observations at *San Diego and San Francisco:* OFFICE-WORK.—To continue the computations and reductions of the field-work; to commence the drawing of *Tomales bay, Cal.,* soundings off *Humboldt bay, Cal.;* to continue that north of *San Francisco entrance,* including *Drake's bay, Cal.;* to complete *Santa Cruz island, Cal., Petaluma creek, Cal., Napa creek, Cal.;* to commence the engraving of *Tomales bay, Cal.,* soundings off *Humboldt bay, Cal., Petaluma and Napa creeks, Cal., Santa Cruz island, Cal.;* to complete *San Pablo bay, Cal.* Also for the operations in—

SECTION XI. *Coast of Oregon and that of Washington Territory.* FIELD-WORK.—To continue the triangulations of *Washington sound,* and of the *Gulf of Georgia,* and of *Puget's sound,* and *Hood's canal,* and the topography and hydrography connected with them; to complete the hydrography of the harbors of the coast; to continue the magnetic and tidal observations required in the section: OFFICE-WORK.—To compute results; to commence the drawing of *San Juan island, Koos bay, Oregon; Gray's harbor, W. T.,* soundings off *Cape Blanco, Oregon,* soundings off *Port Orford, Oregon;* to continue that of *Washington sound, W. T.;* to commence the engraving of *San Juan island, Koos bay, Oregon, Gray's harbor, W. T.,* soundings off *Cape Blanco, Oregon,* soundings off *Port Orford, Oregon;* to continue that of *Washington sound, W. T.,* and the section sketches, will require 100,000

The other items of appropriation asked are small; the items for the line across the Florida peninsula, for fuel and quarters of army officers, and for the pay of engineers, being omitted, for reasons already stated. Those items called for are:

For publishing the observations made in the progress of the survey of the coast of the United States, by act of March 3, 1843	$5,000
For repairs of steamers and sailing schooners used in the survey, by act of March 2, 1853	5,000

The amounts thus estimated for the work of the fiscal year 1862–'63, and the appropriations for the present year, are given in parallel columns:

Object.	Estimated for fiscal year 1862–'63.	Appropriated for fiscal year 1861–'62.
For survey of the Atlantic and Gulf coasts of the United States, including compensation of civilians engaged in the work, per act of March 3, 1843	$178,000	$230,000
For continuing the survey of the western coast of the United States, including compensation of civilians engaged in the work, per act of September 30, 1850	100,000	110,000
For continuing the survey of the Florida reefs and keys, including compensation of civilians engaged in the work, per act of March 3, 1849	11,000	25,000
For completing the line to connect the triangulation on the Atlantic coast with that on the Gulf of Mexico, across the Florida peninsula, including compensation of civilians engaged in the work, per act of March 3, 1843	----------	5,000
For publishing the observations made in the progress of the survey of the coast of the United States, including compensation of civilians engaged in the work, per act of March 3, 1843	5,000	5,000
For repairs of steamers and sailing schooners used in the survey, per act of March 2, 1853	5,000	10,000
For fuel and quarters, and for mileage or transportation, for officers and enlisted soldiers of the army serving in the coast survey, in cases no longer provided for by the quartermaster's department, per act of August 31, 1852	----------	°5,000
For pay and rations of engineers for seven steamers used in the hydrography of the Coast Survey, no longer supplied by the Navy Department	----------	†12,800
Total	299,000	402,800

° Formerly included in estimates of War Department. † Formerly included in estimates of the Navy Department.

DEVELOPMENTS AND DISCOVERIES.

The list given in Appendix No. 6 is made up by additions from year to year of the discoveries and developments incident to the progress of the hydrographic work generally, but including also changes found and reported by the land parties, as in the case of alteration of shore-line either by the encroachment of the sea in any locality, or the contrary. It could not be expected that the lessened means of pushing the hydrographic work, arising, in part, from the necessary occupation of the Coast Survey vessels in revenue and other government service during the greater part of the year, but chiefly from the withdrawal of officers whose attention had been mainly given to their importance, should furnish as many items as usual of special developments. Such as have been made are here enumerated, and will also be found appended to the general list before referred to. The existence of points of rock in Sandy bay, Mass., was made known through Mr. W. P. G. Bartlett, of Cambridge. In sounding in smooth water, and in the only weather suitable for continuous hydrography, such obstacles would be struck

with the lead only by the merest accident. The method employed for determining the exact position of the dangers referred to is stated under the head of hydrography, in Section I.

1. Determination of the positions of four points of rock in Sandy bay, (Cape Ann,) Mass.

2. Special investigation of the currents of Boston harbor.

3. The currents of Cape Cod bay observed with reference to their physical effects on the shores.

4. Discovery of three small banks off the Nantucket shoals, in the vicinity of Phelps's bank, and further development of the extent of that shoal ground.

5. Development, by soundings, of a ridge lying sixteen miles off Barnegat, N. J., with eleven to thirteen fathoms of water, and sixteen fathoms between it and the coast.

6. Special examination made and changes noted in the vicinity of the Five Fathom bank, off Cape May.

7. Hydrographic changes developed in the Delaware river at the Bulkhead shoal, near Fort Delaware; at the bar off Fort Mifflin; and opposite to Philadelphia.

8. Development of important changes in the hydrography of the bar and channels of Hatteras inlet, N. C.

HYDROGRAPHIC NOTES.

During the past season I have prepared a series of hydrographic notes of the coast for the especial use of the War and Navy Departments. In these I have been aided by the experienced assistants of the Coast Survey, and especially by Carlile P. Patterson, hydrographic inspector, Professor W. P. Trowbridge, assistant, C. O. Boutelle, assistant, and F. H. Gerdes, assistant. These notes have been furnished, through the depot of charts and instruments of the navy, to such officers as the superintendent of that establishment deemed it proper to supply; also directly from the Coast Survey to bureaus of the War and Navy Departments, and to officers in charge of expeditions. To these notes all the maps of localities which could be rapidly prepared are attached.

The first copies of the notes were submitted to the blockade conference, referred to in the report of the honorable Secretary of the Navy, and consisting of Capt. S. F. DuPont, U. S. N., the undersigned, Superintendent of the Coast Survey, Brigadier General Barnard, U. S. A., and Commander Chas. H. Davis, U. S. N.

SPECIAL SURVEYS.

To meet the purposes for investigation of a commission, consisting of the chief engineer, General Joseph G. Totten, Commander Charles H. Davis, and myself, authorized to advise in regard to the preservation of Boston harbor, a resurvey of parts of the harbor was commenced last year, as stated in my annual report. The work required has been continued, and has included the revision of some further portions of the topography, and a thorough examination of the currents of the inner harbor and those of Charles river. The objects sought are the causes of hydrographic changes which have occurred, and the study of them is not the less interesting because complex and laborious. To the patience and zeal of Assistant Henry Mitchell, who has conducted throughout all the observations required by a physical survey, much credit is due for his steady and thorough attention to the objects kept in view by the commissioners. In addition to the observations recorded last season, numerous current stations have been occupied, and the influence of the bridges upon the tides and currents determined by many experiments. Although our results are of the most direct and practical character, we find at every step some points of scientific value, and of more than local interest. Among these I may mention the curves of density of the water determined for different tidal phases and for different distances from the mouth of Charles river. To these curves very peculiar forms are given by the two variables, *chemical diffusion* and *mechanical mixture*.

The work in Boston harbor has been made the subject of several special reports by the United States commissioners, who have instituted these inquiries at the request and at the expense of the city government.

The same commissioners, under the auspices of the legislature of Massachusetts, having under consideration certain questions involved in the proposed construction of a ship canal across Cape Cod peninsula, current observations have been made for their use at various stations in Cape Cod bay. The objects in these were to develop more fully the character and causes of a coast current discovered last season, and to furnish information relative to the race near Provincetown. In these undertakings Assistant Mitchell was very successful, and the commissioners are furnished with ample data for a special report on these subjects.

Experiments on the temperatures and density of the sea were made incidentally in connexion with the current observations, and have shown some important relations. The cold region off the eastern terminus of the proposed Cape Cod canal proves to be a cropping out of the cold substratum of the sea due to the coast current, which passes up into shallow portions of the bay. The mean temperature of the surface water off the mouth of Scusset river, for the month of July corresponds with the temperature of the sea off Race Point at a depth of about *twenty fathoms*. At this latter point the surface water was found in July to be about fifteen degrees higher in temperature than that of the lowest stratum. This contrast of temperatures is favored by the *increase of density with the depth*, which was distinctly detected by the hydrometer. The variation in specific gravity seems to exceed the greatest possible range due to changes of temperature. If this be so there should be very little alteration in the temperatures of the greatest depths for the different seasons, and the cropping out place near Scusset should in midwinter be warmer than the general surface water of the bay; a practical result of the highest value.

In a report made to a committee of the Massachusetts legislature last year by the United States commissioners we announced the discovery of the *cropping out* referred to above, and suggested that the phenomenon had an important relation to the success of the proposed Cape Cod canal and artificial harbor, especially with regard to the much vexed question of the freezing up in winter. An appropriation for a special study of this subject has been made by the legislature. The observations required to determine the question have not yet been completed.

Assistant Mitchell carried his investigations along the outer coast of Cape Cod, and found another cropping out of sub-currents (cold in midsummer) a mile from the shore of the peninsula, off Nausett.

Under authority of the Treasury Department, and by request of the commanding general of the army, topographical surveys in the vicinity of the capital have been made, as will be more fully described under the appropriate head, with notices of work done in Section III.

TIDES.

The tidal stations occupied, and results obtained from them, are shown in Appendix No. 10, and the office occupation connected with the observations in the report of Assistant L. F. Pourtales, as chief of the tidal division of the office, Appendix No. 12.

The tide tables prepared for the use of navigators were revised in May last, and, under the demand which then existed, were printed in pamphlet form and distributed from the Coast Survey office and from the Naval Observatory, for the use of government vessels. These tables are included with this report, as Appendix No. 9.

INFORMATION FURNISHED.

Appendix No. 4 gives, in the usual form, a synopsis of the general information furnished from the office during the year, in answer to special calls. The regulation of the department

under which data are supplied to applicants, requiring merely that acknowledgment be made in the title of any publication in which it might be embodied, has been adhered to. When tracings or abstracts from the archives requiring time in their preparation are called for, the actual cost, at the working rates, is defrayed by the applicant.

For obvious reasons, the list referred to does not include the mention of a large amount of special information supplied at the call of the various departments of the government, and to officers in every branch of the public service.

STATISTICS.

The table of statistics has been added to, so as to bring it up to the opening of the present surveying year, and is given in Appendix No. 5.

Up to 1860, inclusive, the triangulation had covered an area of nearly sixty-one thousand four hundred square miles; had developed a general extent of coast of over four thousand three hundred, and a shore-line of about twenty-one thousand seven hundred miles, determining nine thousand and fifty geographical positions.

For longitude determinations eighty-three stations had been occupied; for latitude, one hundred and twenty-five; and for azimuth, eighty-two stations.

The topography had extended over an area of sixteen thousand two hundred square miles, having a general coast line of over three thousand seven hundred, and more than forty thousand miles of shore-line, measuring the indentations.

The hydrography extended over an area estimated at forty-five thousand four hundred square miles, in which more than one hundred and ninety-three thousand miles were run in sounding; six million one hundred and seventy-four thousand soundings made, and over eight thousand two hundred specimens of the bottom obtained.

The number of manuscript maps and charts was two thousand and sixty-eight, and of engraved maps, charts, and sketches, four hundred and seventy plates.

DISTRIBUTION OF REPORTS AND MAPS.

The distribution of the report of 1859 has been confined to individuals and institutions in the loyal States of the Union. Of the six thousand two hundred extra copies ordered by the Senate and five thousand by the House of Representatives, eight thousand were to be distributed from the office. It has been judged expedient during the past year to suspend the usual foreign distribution through the Smithsonian Institution.

More than twenty-one thousand copies of maps, charts, and sketches have been sent from the office since the date of my last report—a number exceeding the average yearly distribution by thirteen thousand. This large increase has been due to the demands of the War and Navy Departments, every effort to supply which will continue to be made.

LONGITUDE.

This subject has received two very important additions from the pen of Professor Benjamin Peirce, of Harvard. The first, (Appendix No. 16,) entitled "*Report upon the determination of the longitude of America and Europe from the solar eclipse of July* 28, 1851," embraces a discussion of all the observations published in this country and in Europe, divided into the following five classes: 1. European observations, which record the beginning and the end of the eclipse at the same place; 2. European observations, of which the duration of the eclipse is used, but indpendent observations of the beginning and end rejected for want of a reliable longitude; 3. European observations, of which only one phase of the eclipse is used; 4. European observations; 5. American observations. Hansen's lunar tables were employed in the computation. The conditional equations are divided into two sets, one involving the interval of duration, the

other the mean time of phases. The final equations contain, as quantities to be determined, the correction to the adopted sum of the semi-diameters, that of the tabular longitude, and that of the assumed longitude of America. The longitudes of seven American stations are determined, and the probable error of the final result for the longitude of Washington is only half of a second of time.

The second paper (Appendix No. 17) contains the first fruit of a plan adopted for the determination of our longitudes, by observing occultations of the Pleiades. To render this rather intricate reduction more generally useful, I have thought it expedient to insert the report of Professor Peirce in full, as an example for similar computations. The period between the years 1838 and 1842 is now under discussion, and the example given treats the emersions of September 26, 1839. Observations, taken at six places in Europe and America, have been collected. To the method of reduction which was given in Appendix No. 24 of my annual report for 1856 some auxiliary formulæ have since been added. In the computation Hansen's lunar tables were used. The probable error to be assigned to the final result for longitude from all the occultations is estimated not to exceed one-tenth of a second of time, and the greater part of that estimated error is due to uncertainty in the lunar parallax. The longitude deduced in this example agrees well with the result found by the discussion given in the preceding paper.

In Appendix No. 18 will be found an abstract of the elaborate report made by Dr. B. A. Gould, on the difference of longitude between the cities of Albany and New York. The line of telegraph was used for the observations, connexion being made through it between a station in the grounds of the Dudley Observatory, at Albany, and the private observatory of L. M. Rutherford, esq., in New York city. The method employed is the same that has been applied to the determination of the longitude of all the principal points on the coast of the Atlantic and Gulf of Mexico, and has been repeatedly mentioned in my previous reports.

SOLAR ECLIPSE OF JULY 1860.

In addition to the observations of this eclipse, given in my last annual report, I have inserted in the Appendix of this report (Nos. 19, 20, and 21) abstracts of the observations made at the Coast Survey station on Gunstock mountain, and at Cambridge, Mass., and Washington city. It is expected that the combined observations of this eclipse will yield a valuable result to the determination of our principal longitudes.

OCCULTATIONS OF PLEIADES, ETC.

During the past year the charts of predictions of occultations of the Pleiades have been forwarded, in pursuance of the general plan proposed by Professor Peirce, of Cambridge, Mass., and committed to his execution. The computations have been made, as heretofore, by Mr. Edward Pearce, jr., under the general direction of Professor Peirce.

The list embraced twenty-eight stations in Europe and twenty-four in America.

Charts for the series of December 24, 1860, were forwarded to the foreign and to the American stations, and for the series of February 17, 1861, to the foreign stations only, the occultations of that date not being visible in America.

Returns of forty-nine results have been received from the American stations.

The records of twenty-six moon culminations, observed at Cincinnati, have been furnished by Professor O. M. Mitchel.

MAGNETISM.

In this department of science three contributions have been furnished for this report by Assistant C. A. Schott, and will be found in the Appendix, Nos. 22, 23, and 24. The first one treats of the secular change of the horizontal and total intensity of the magnetic force at a

number of stations along our Atlantic, Gulf, and Pacific coast, to which some adjacent foreign stations have been added. This paper, like the preceding ones on the secular change of the other magnetic elements, gives us the means of referring observed intensities to a common epoch, for the purpose of comparison and combination. The comparatively short period of time since intensity observations were first made, (beginning with the present century,) as well as the difficulty of expressing the older relative values in absolute measure, has necessarily delayed the investigation, at least until approximate results could be expected from the material. The discussion embraces thirty-six stations, with a total of two hundred and seventy observations collected, and now combined for the present investigation. All values have been expressed in the English units of grains and feet. On the Atlantic coast the horizontal force is found decreasing; on the Pacific coast it is increasing; but the total force is very nearly stationary.

The second paper (Appendix No. 23) contains a new discussion of the magnetic declination along the coast of the Gulf of Mexico, a paper of direct practical character and of scientific interest. The epoch to which all the observations were referred is January, 1860, and the discussion is therefore an enlarged edition of my paper on the distribution of terrestrial magnetism, for the epoch 1850, given in the appendix of the annual reports for 1855 and 1856. The earliest observation admitted in the new discussion was made in 1840, and the total number used is thirty-six, or more than twice the number used before. The secular change is fully discussed within the limits of the paper. Some few observations were admitted from other than Coast Survey records. The most approved formula was employed for the analytical expression of the distribution of magnetism, for which purpose six groups were formed. The probable error of a single representation is very small. This, as well as the next paper, concerning the variation of the compass, was prepared for the immediate use of our naval squadrons, and the results of both were printed in pamphlet form and furnished to the proper officers of the government during the summer.

The third paper (Appendix No. 24) shows the distribution of magnetic declination in January, 1860, along the lower part of the Atlantic coast of the United States. The discussion is similar to that in the preceding paper, and comprises twenty-one observations. The results are shown graphically for the Atlantic coast and for the Gulf of Mexico in Sketch No. 30.

SOLAR SPOTS.

In Appendix No. 25 are given the records of these observations to January, 1862, made by Assistant Schott, in continuation of a series published in the appendix of my last annual report. Their probable connexion with terrestrial magnetism has been heretofore discussed.

HEIGHTS.

The collection of data for representation on a map of heights in North America, carried on in conjunction with the Smithsonian Institution, has been continued during the past year. About fifteen hundred points have been obtained since last year's report, making, in all, over fourteen thousand points, derived from explorations for roads and railroads and geological surveys, as well as from the constructed lines of canals and railroads.

The collection of maps of States, counties, and minor details made during the prosecution of this work, by Mr. W. L. Nicholson, has been of service in the present demand for precise knowledge of the topography of the interior; bringing out, at the same time, more and more, the need for thorough trigonometrical surveys to reconcile and avoid the discrepancies in positions and the omissions apparent in so many of the existing maps of the interior.

EXPERIMENTAL INQUIRIES.

Though the interest in regard to improvements in instruments and apparatus has not been lessened, but few occasions during the year have called for the application of implements not already in use. A new form of sounding apparatus, devised by Professor W. P. Trowbridge, to register depths in comparatively shallow water, has been tried with success. The results are given in Appendix No. 11.

In the office, experiments have been made to test the relative accuracy, for critical purposes, with reference to the shrinkage and expansion of manuscript maps on parchment paper, as compared with the same if made on backed drawing paper. The results, given in Appendix No. 15, and also shown graphically in Sketch No. 31, are conclusive in favor of the paper backed with common muslin.

OFFICERS OF THE ARMY.

The names of officers of the army on Coast Survey service at the opening of the present surveying year are given in Appendix No. 2, as also the dates at which some were detached by orders from the War Department, and at which others resigned. Of twelve officers then attached, and qualified not only by natural aptitude, but also by experience in the field or office, only two remain on the list, both actively engaged in their profession, and ready for calls which would necessarily be preceded by orders detaching them formally. Captain (now Major) W. R. Palmer, of the corps of topographical engineers, is still in charge of the Coast Survey office, but is also actively on duty as a member of the staff of the commanding general. Captain T. J. Cram, of the same corps, an officer of great experience in field service in the survey, is at present on military duty at Fortress Monroe, though not withdrawn from the employments of the Coast Survey by formal order. With the loss of his assistance must be counted that of Lieutenants George Bell, O. D. Greene, W. R. Terrill, and W. Craig from the list of field assistants, and Lieutenants J. R. Smead, N. H. McLean, and Thomas Wilson from the Coast Survey office, detached on the 18th of April in consequence of the crisis which was then hastening in the affairs of the nation. Three other officers, viz: Captain M. L. Smith, of the topographical engineers, and Lieutenants R. G. Cole and W. G. Gill, had previously resigned, the first at the beginning of April, the second on the 10th of January, and the last named at the beginning of February. These officers were at those respective dates either engaged or making preparation for continuing field duties, which all of them had discharged acceptably in the preceding season.

Aside from their qualifications for the work of the Coast Survey, on which it would be here in place to remark, I would take the occasion to place on public record, as less than their due, official mention of the inflexible spirit of loyalty manifested by the younger officers previous to the emergency which withdrew them in April last. My regret in parting with them has been tempered not only by the occurrences which returned them to the line of their profession, but also by the cheering conviction that the spirit which has carried them through great personal trials has been committed to men who are not likely to be moved by any but principles of consistency and honor. The fact may be passed that the confusion of social relations only in a slight degree affected several of the officers referred to. The trial of principle in the case of two, at least—Lieutenants Terrill and Bell—was such as few men have met, and fewer resisted. That in the emergency which had arisen such men were found in positions of special usefulness, in which they had engaged when the calls of their profession were not imperative, cannot be regarded as fortuitous. The way being open, they pressed in, accepting toil and hardship cheerfully on the road to usefulness. One was engaged in triangulation on the coast of Florida, and the other on the coast of Texas, when our national affairs became involved. Both were energetic and sagacious in the discharge of duty, and both bid fair to rank with

the ablest, as they do with the most highly esteemed, officers who have been associated with the labors of the Coast Survey.

The charge of the Drawing Division, the operations of which had been directed for several years with marked ability by Lieutenant Thomas Wilson, was, soon after his detachment from the survey, assigned to Captain T. J. Lee, with the sanction of the Treasury Department. The precision in details and method practiced by Lieutenant Wilson in conducting work have added much to the efficiency of the division.

Lieutenant G. H. Elliot, of the corps of engineers, continues the supervision of the tidal observers on the Western coast, under an arrangement which, as it does not interfere with his general duties, has been cordially acceded to by the chief engineer of the army.

OFFICERS OF THE NAVY.

When the surveying year opened, the prospects in regard to the hydrographic work laid out for execution were bright. The number of officers spared by the Navy Department was small, but they were well acquainted with the requirements of the survey, and, under ordinary circumstances, they would have sustained amply the reputation which they had rapidly earned as skilful and energetic hydrographers. Commander James Alden was detached, at his own request, in October, 1860, and had been replaced on the list by the assignment of Commander D. D. Porter to the charge of the hydrographic work on the Western coast. The last-named officer, whose experience on the survey in former years, and well-known energy and intelligence, gave large promise of public benefit, had completed his preparations for proceeding to the Pacific coast just before our national troubles began to take shape. An early occasion requiring, for the immediate honor of the government, the strength of an indomitable will, and loyalty as inflexible, took him necessarily from the list on which his name had stood so high. This was at the end of March. Events which quickly followed in the record of national disaster withdrew the officers then left in the service of the Coast Survey, with a single exception, the immediate necessities of the government requiring that at least one trained hydrographer should remain subject to its call for special duty. The allotment fell on Lieut. Comg. T. S. Phelps, whose labors have not intermitted throughout the year. Lieut. Comg. J. C. Febiger was detached on the 22d of May, and Lieut. Comg. J. P. Bankhead on the 8th of June. The first-named officer had been only recently assigned to a second period of duty in the survey, and the second was under instructions, at the opening of the season, for the prosecution of work in which he had previously shown great zeal and aptitude. Allusion will be made, under another head in this report, to the site of work and duties assigned to this able officer, and to the circumstances which made their execution impracticable.

There being at the critical juncture in public affairs which was passing in May no hydrographic officer on the Western coast, the honorable Secretary of the Navy, at my suggestion, assigned for that important duty Commander B. F. Sands, an officer of large experience, prudence, and ability. As was expected, Commander Sands has since that date co-operated with the military authorities in California in active service, (see Appendix No. 32,) and when the emergency passed which had called for it has advanced the hydrography. His resources, gained by previous duty on the Coast Survey, and natural energy of character, abundantly qualify him for sustaining the interests of the government in either line of service within his profession, as circumstances may require. Appendix No. 3 gives, in the form of a list, the names of all the officers who were attached to the survey last spring, and the dates at which they were either severally detached, or withdrew from the service. The efficiency of the hydrographic office, which had been left vacant by the departure of Commander S. S. Lee and Lieutenant Silas Bent at the end of April, was restored early in May by Captain Carlile P.

Patterson, formerly of the United States navy, and assistant in the Coast Survey, who was assigned to duty in that division of the office under authority of the Treasury Department.

Of the other officers whose names are given in the list in Appendix No. 3, three, viz: Commander W. T. Muse, Lieutenant John Wilkinson, and Lieutenant C. M. Fauntleroy, had been engaged in hydrographic duty during the preceding autumn. The labors of each of them had been marked by zeal and success. Lieutenant R. P. Pegram had been recently assigned to duty in the survey, and was preparing for service afloat when he resigned from naval service.

AIDS TO NAVIGATION.

The result of an examination, made by direction of the Treasury Department, with reference to the expediency of erecting a light-house at the entrance of Gray's harbor, W. T., is given in Appendix No. 34.

The usual progress of the hydrography has brought to the notice of the chiefs of parties in previous seasons the desirableness of minor aids to navigation, as beacons, buoys, and leading marks in the vicinity of channels. These have been communicated from time to time for the information of the Light-house Board. This year, by reason of the fact that along a large part of the coast of the United States the light-houses and day marks have been destroyed, the remarks have been confined to few localities, and chiefly refer to replacing marks that had previously existed.

OBITUARIES.

The opening of the present surveying year was sadly marked by the death of Mr. A. W. Thompson. He entered the survey in March, 1857, and until within a short period before his decease was steadily engaged in field duty, where, by his gentleness and devoted fidelity to the interests intrusted to him, he won the esteem of all with whom he was associated. Mr. Thompson served as a volunteer in the astronomical expedition to Labrador in July, 1860, and after its return rejoined the field party with which he had been previously on duty. While on service with the expedition he contracted a cold which ended in consumption, of which he died, at his home in Philadelphia, on the 19th of December, 1860.

Another of the aids, Mr. M. O. Hering, of excellent attainments in that grade, died of the same wasting disease on the 6th of November, after a lingering illness. He had served with constant fidelity during several years, and his varied talents—having, amongst other qualifications, considerable skill as a draughtsman—were always brought to bear fully in the furtherance of any work with which he had to do. Mr. Hering had also been attached to the Coast Survey office, and was highly esteemed for his kind and manly disposition.